AI Argus

A Unique Insight Into Logistics

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CONTENT

- AI Argus Introduction
- Scenario Analysis and Algorithm Design
- Acceleration with NVIDIA
- Future Planning

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Argus Introduction

LPSS

Loading Procedure Structuring System

Vehicle License Plate Analysis

Vehicle Trajectory Analysis

Loading Rate Detection

Staff Efficiency Analysis

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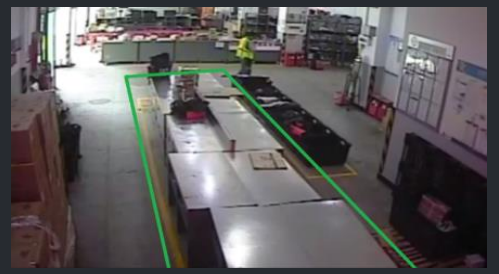
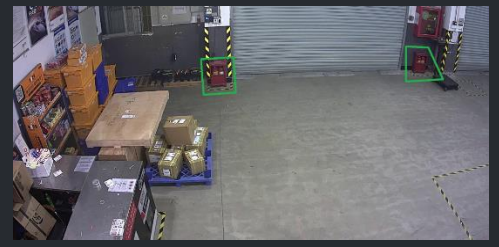
VAPD

Violated Action Pattern Detection

Violent Operation Detection



6s Regularization Detection



Safety Production

Business Management

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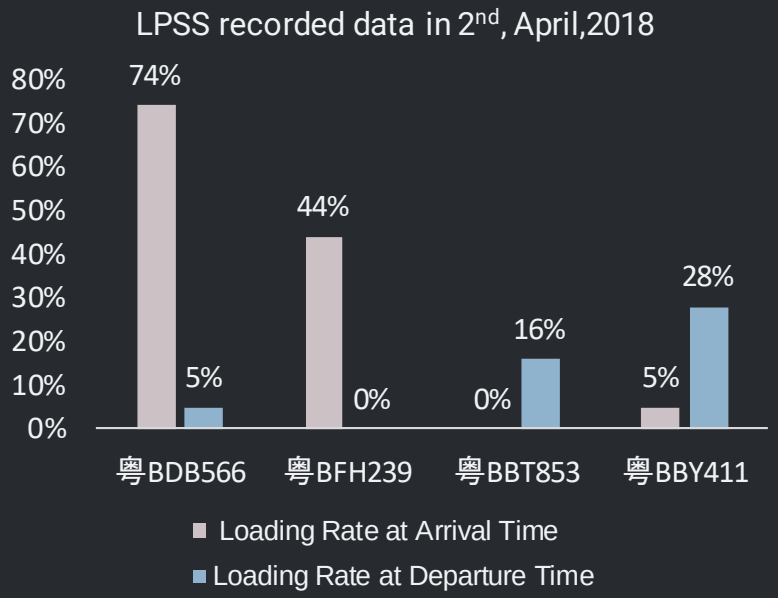
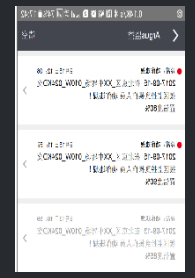
Argus Cloud Service



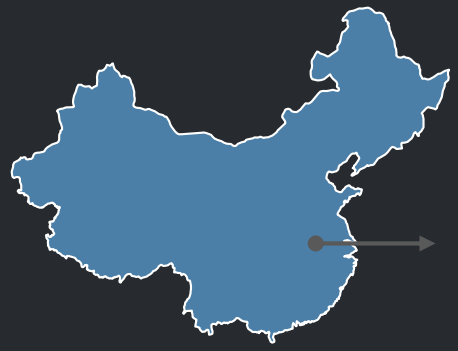
Trend Graph

Push Notifications

- Web
- APP



Ranking List.



Condition Monitoring

Config

Computing Node

camera

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Scenario Analysis and Algorithm Design

Scenario Analysis

Sorting Center

01
Loading Gate Operation Analysis

02
Behavior Monitoring

03
Equipment Monitoring

04
Specific Area Monitoring

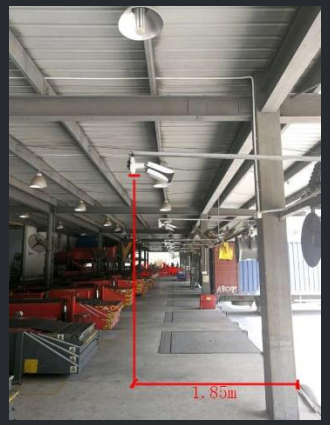
Distribution Center

01
Standardization management

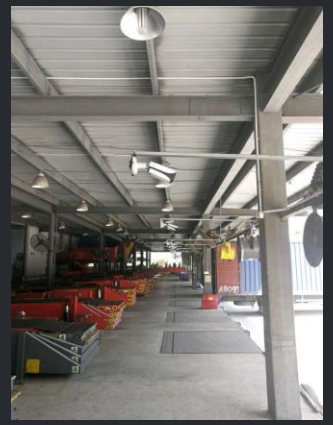
02
Behavior Monitoring

03
Tool Positioning Detection

04
Safety Production







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LPSS Active Data Collection for Unfamiliar Scenes and Transfer Learning

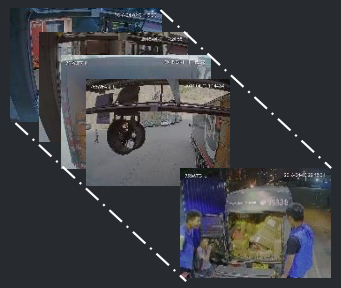
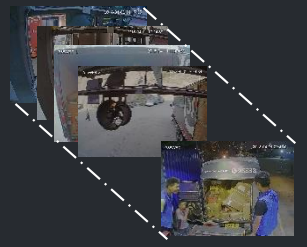


Image Database

Unseen Sample



Database

New image

VGG16

VGG16

32bit binary codes

calculate hamming distance

32bit binary code

>thres hold

yes

update

discard

no

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Loading Gate Working Status and Staff Efficiency Analysis

01 Optical Flow Calculator

02 Action Detection

flow_x+flowy+gray

merge

Pelee-net

arrive

Classification result

03 State Machine

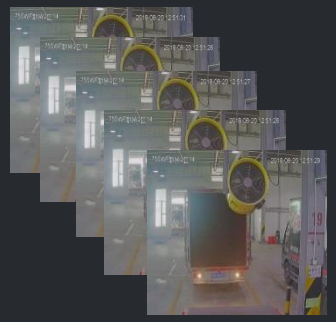
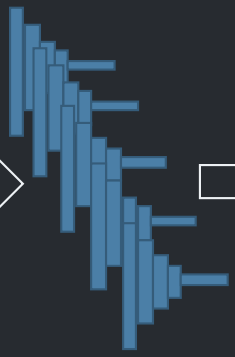


Image sequence

flow+gray merge sequence



Pelee net

arrive
arrive
arrive
arrive
arrive

Classification result

arrival

State machine result

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Vehicle License Plate Analysis

What you expect to see **VS** What Argus actually sees

Asymmetric Illumination | Partial Covered | Image Blur | Deformation/Soiling

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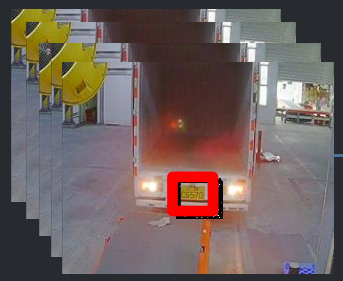
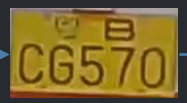
Vehicle License Plate Analysis

Object Detection	Image Quality Assessment	Attention OCR

Video (Image) → SSD+tracker → GoogleNet → CNN+LSTM+CTC → end



SSD

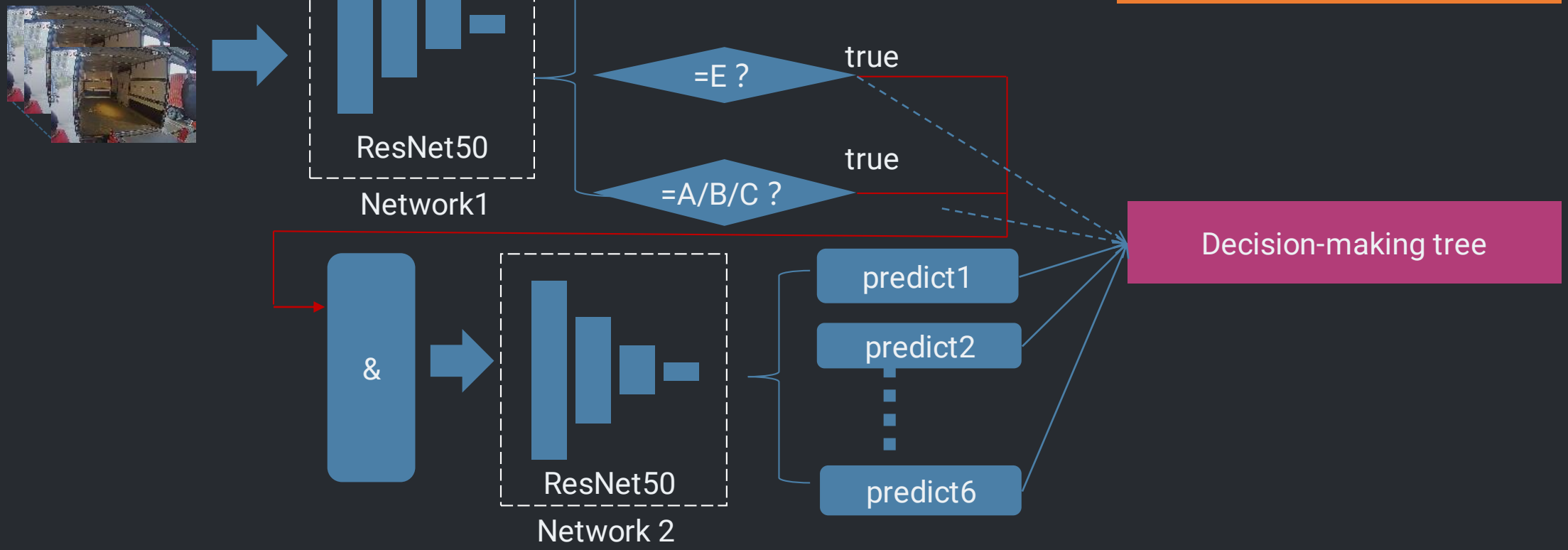


GoogleNet

CNN+LSTM+CTC → SoftMax → 粤BCG570

LPSS

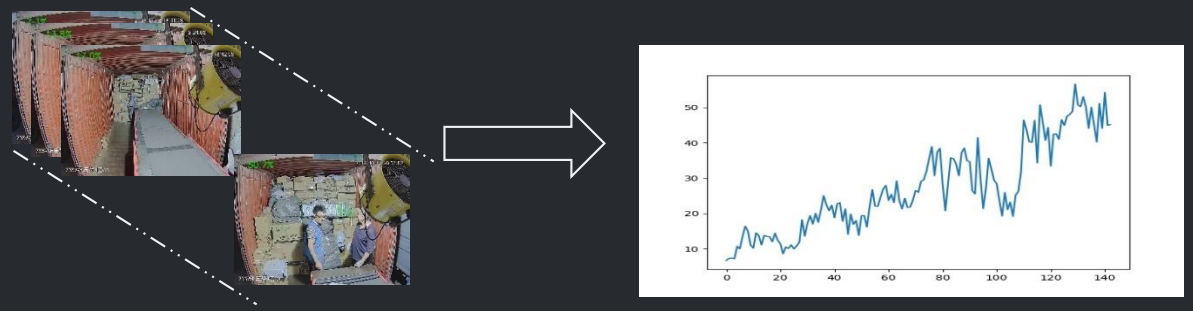
The Instant Loading Rate Detection

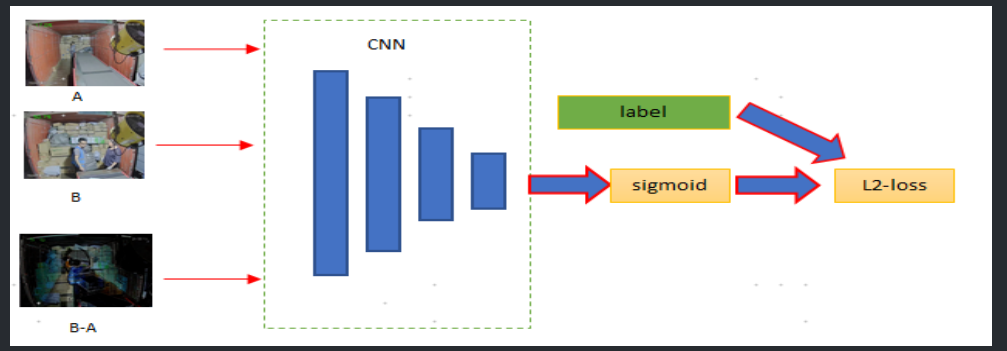


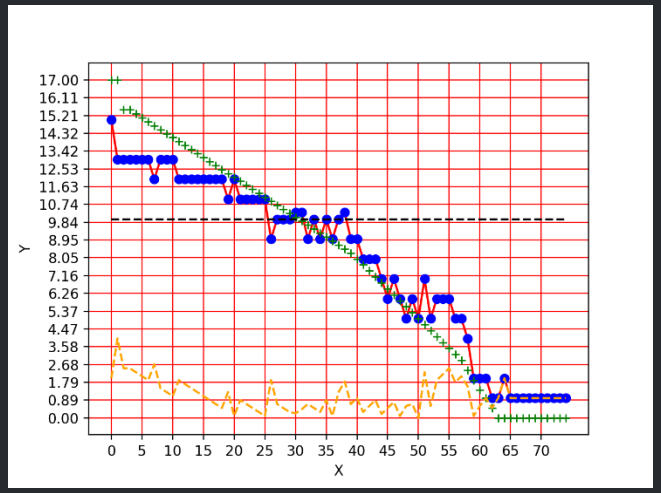
LPSS

The Process Loading Rate Detection

Variable Length Sequence Feature Learning







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LPSS

- Vehicle License Plate
- Gate Number
- The Vehicle Arrival Time
- Loading Rate at Arrival Time
- Working Start Time
- Working End Time
- Loading Rate at Departure Time
- The Vehicle Departure Time
- Working State judgment

Structured Data List

Vehicle License Plate	Gate Number	The Vehicle Arrival Time	Loading Rate at Arrival Time	Start Time	End Time	Loading Rate at Departure Time	The Vehicle Departure Time	State
粤BDB566	No.1 uploading gate	2018-04-12 22:07:53	74%	2018-04-12 22:07:59	2018-04-12 22:23:24	5%	2018-04-12 22:23:34	uploading
粤BFH239	No.1 uploading gate	2018-04-12 22:24:16	44%	2018-04-12 22:24:20	2018-04-12 22:44:29	0%	2018-04-12 22:44:39	uploading
粤BGZ502	No.2 uploading gate	2018-04-12 22:45:41	95%	2018-04-12 22:45:45	2018-04-12 23:13:40	0%	2018-04-12 23:13:45	uploading
粤BV8026	No.1 loading gate	2018-04-12 22:13:54	5%	2018-04-12 22:13:59	2018-04-13 01:21:34	49%	2018-04-13 01:21:40	loading
粤B3G15U	No.2 loading gate	2018-04-13 03:34:48	5%	2018-04-13 03:34:54	2018-04-13 04:07:05	79%	2018-04-13 04:07:12	loading
粤BZ5717	No.12 loading gate	2018-04-12 22:21:15	0%	2018-04-12 22:21:21	2018-04-13 02:18:49	85%	2018-04-13 02:18:56	loading
粤BBT853	No.13 loading gate	2018-04-12 22:10:06	0%	2018-04-12 22:10:11	2018-04-13 01:00:58	16%	2018-04-13 01:01:04	loading
粤BBY411	No.16 loading gate	2018-04-12 22:08:10	5%	2018-04-12 22:08:14	2018-04-13 03:51:56	28%	2018-04-13 03:52:15	loading

VAPD

The Illegal Throwing Behavior Detection

challenges

Pushing a box is not an Illegal Throwing Behavior.

ACTION RATING

Throwing a file is not an Illegal Throwing Behavior.

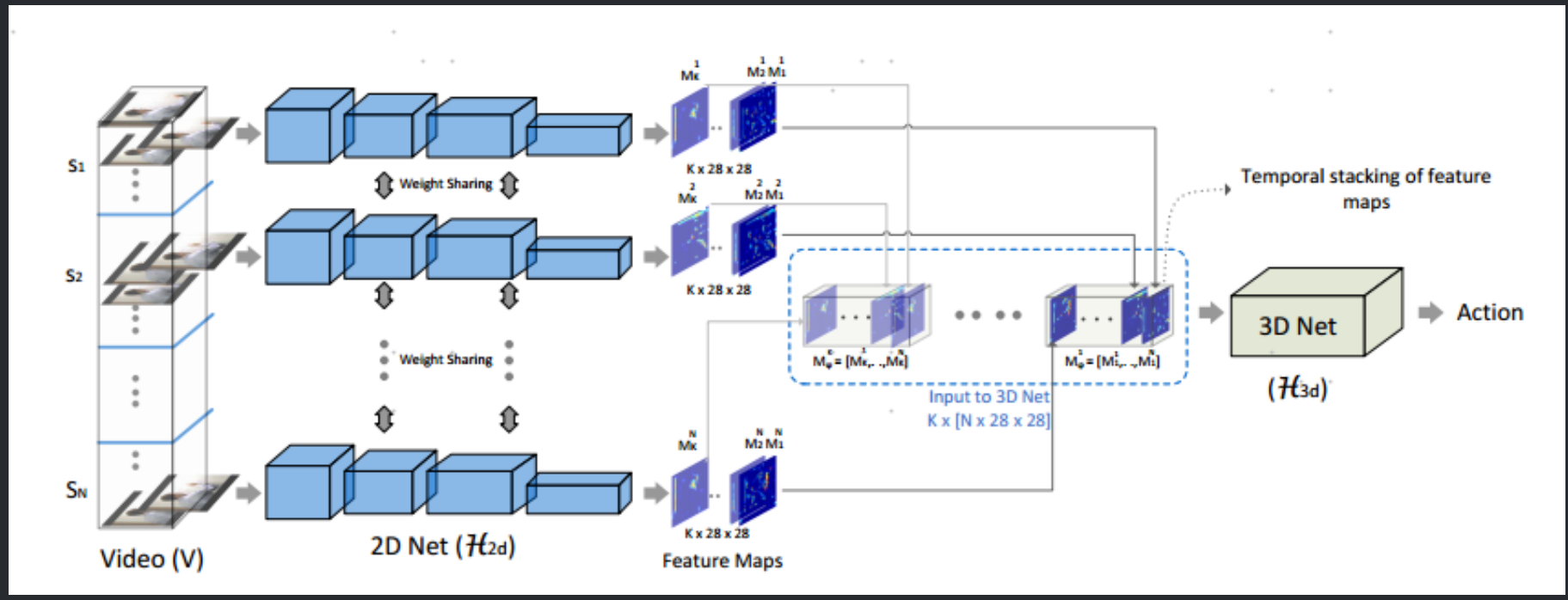
PARCEL TYPE

A short distance throwing is not an Illegal Throwing Behavior.

SPATIAL DISTANCE

VAPD

The Illegal Throwing Behavior Detection



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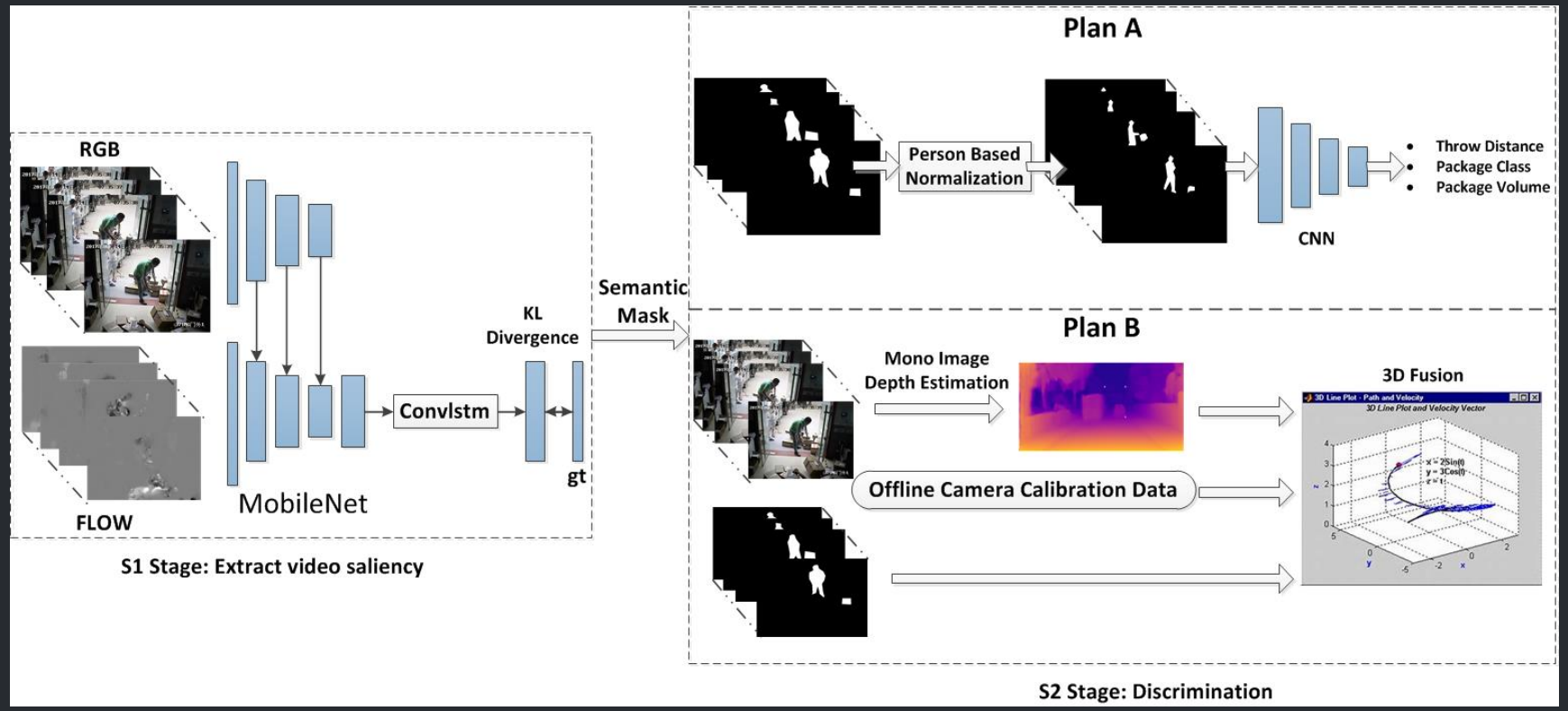
VAPD

Fine Grained Illegal Throwing Behavior Detection via ROI Extraction and 3D Space Recovery



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VAPD

Structured Data List

- Warning Start Time
- Latest Warning Time
- Number of Continuous Warning
- Duration
- Time of violation
- Precision

Warning Start Time	Latest Warning Time	Number of Continuous Warning	Duration	Time of violation	Precision
2018/11/29 15:33:50	2018/11/29 15:33:50	1	15.0s	1	67%
2018/11/29 15:13:35	2018/11/29 15:13:35	1	15.0s	1	91%
2018/11/29 14:41:08	2018/11/29 14:41:08	1	2.0min	2	50%
2018/11/29 14:20:41	2018/11/29 14:20:41	1	15.0s	1	86%
2018/11/29 13:48:43	2018/11/29 13:48:43	1	15.0s	1	52%
2018/11/29 13:47:51	2018/11/29 13:47:51	1	15.0s	1	84%
2018/11/29 13:43:39	2018/11/29 13:43:39	1	15.0s	1	79%
2018/11/29 12:53:50	2018/11/29 12:53:50	1	25.5s	1	72%

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Acceleration with NVIDIA

Technology Stack - Edge

User Applications

Loading Monitoring

Action Recognition

Retail Analytics

Smart City

3D Perception

Argus Edge Framework

Payload

Frame Pool Frame Stack Pre-Processing Primitives
Parallel Processing Queue Inter-Process Communication
HTTPS Token Encryption Asynchronous I/O Interface
Heterogeneous Computing Memory Model

Daemon

Node Status Report System Failure Recovery
In system upgrade Initial Setup Flow
Video Quality Assessment
Multi-Payload Management

TensorRT DeepStream CUDA

x86 / ARM 64bit Linux Distribution

Nvidia Tesla P4 / Xavier

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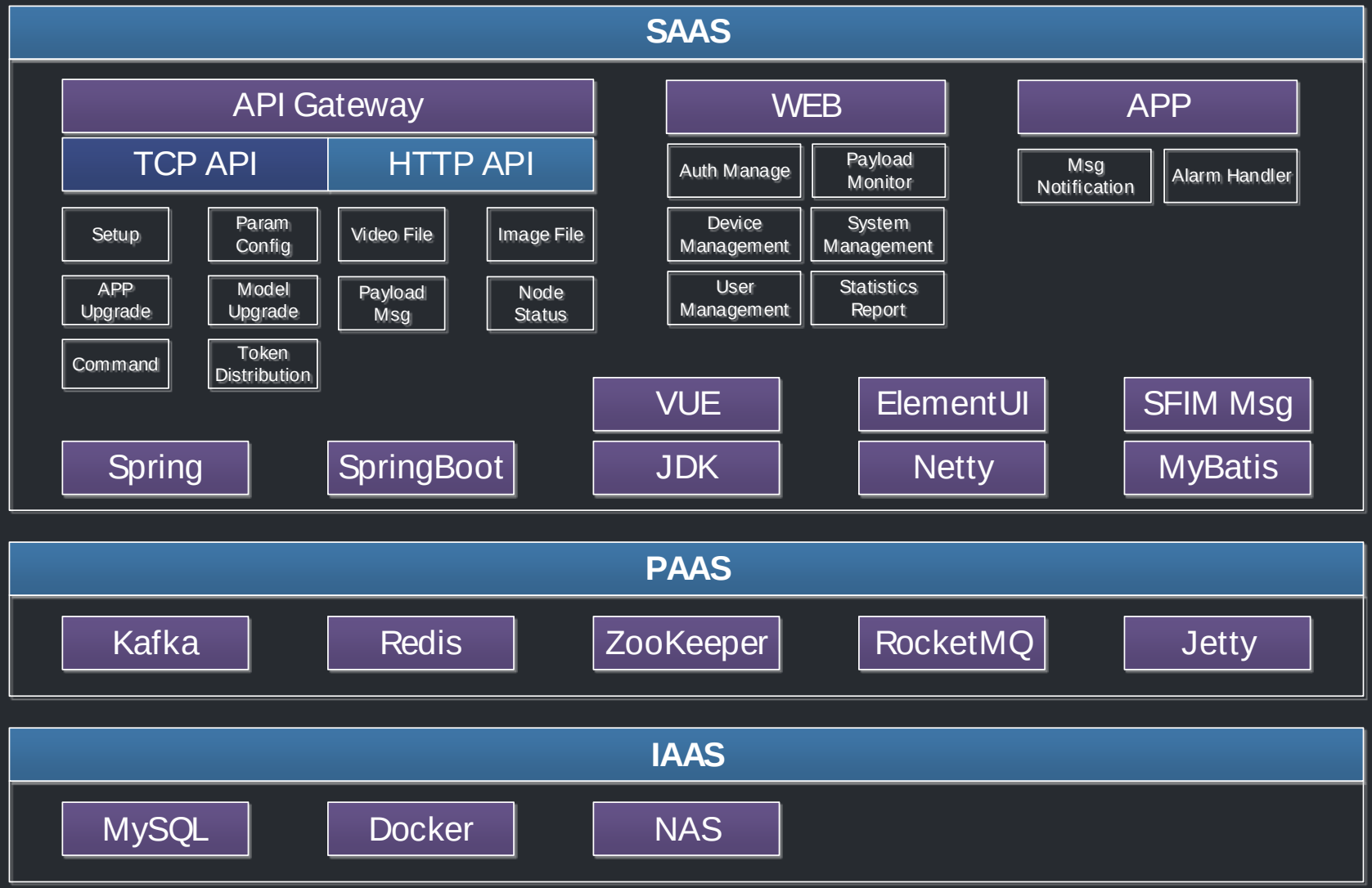
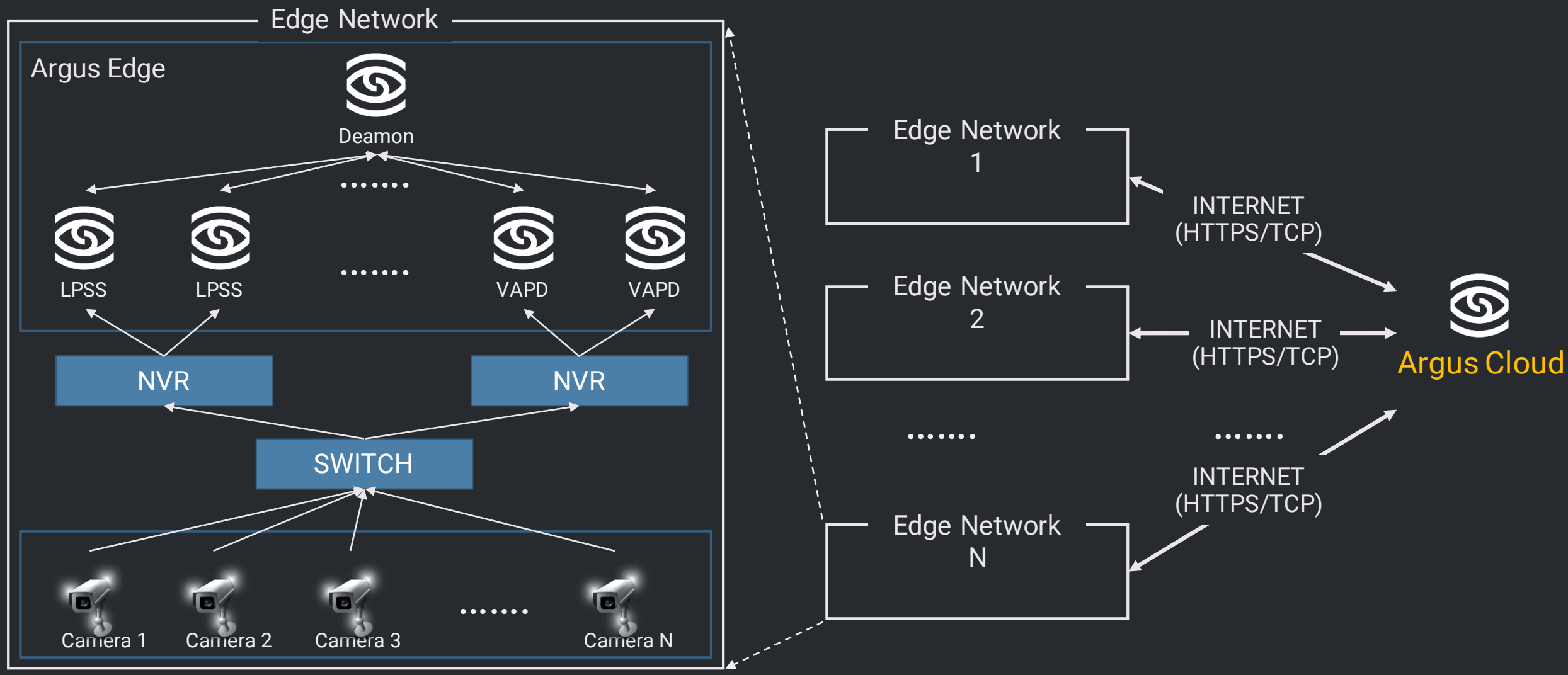
Technology Stack - Cloud



Argus System Architecture: Edge Computing



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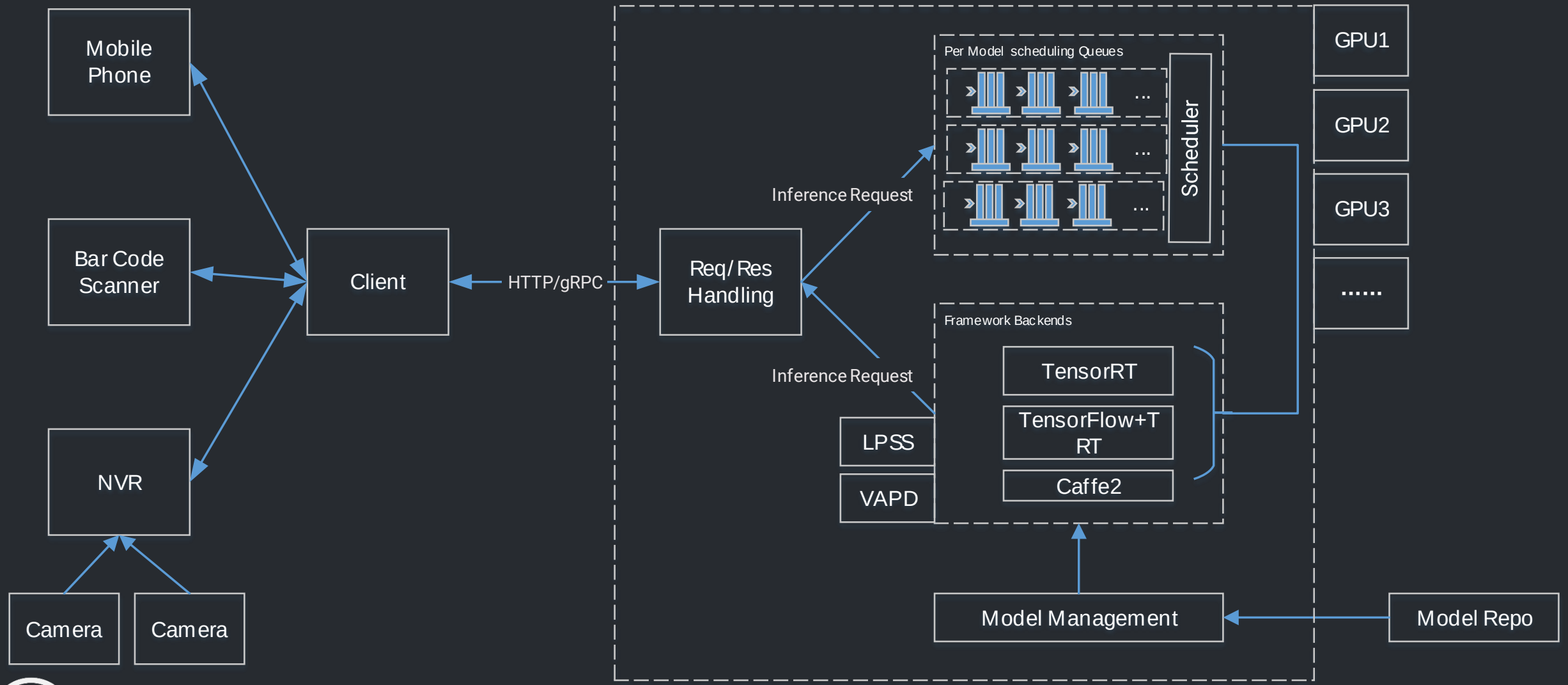
Argus System Architecture: Cloud Computing



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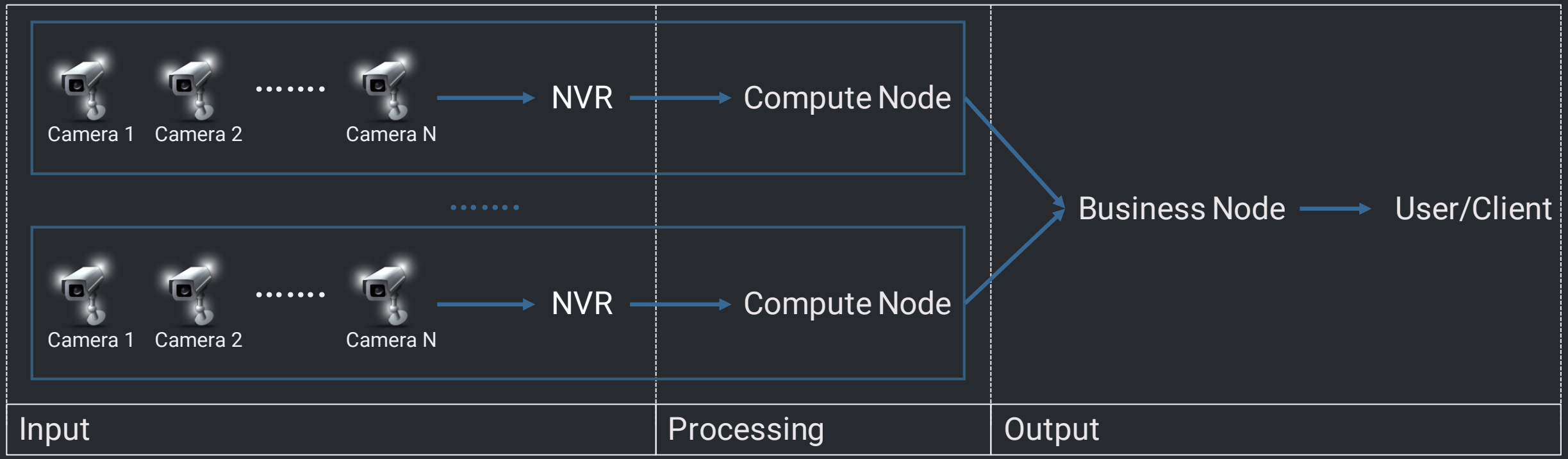
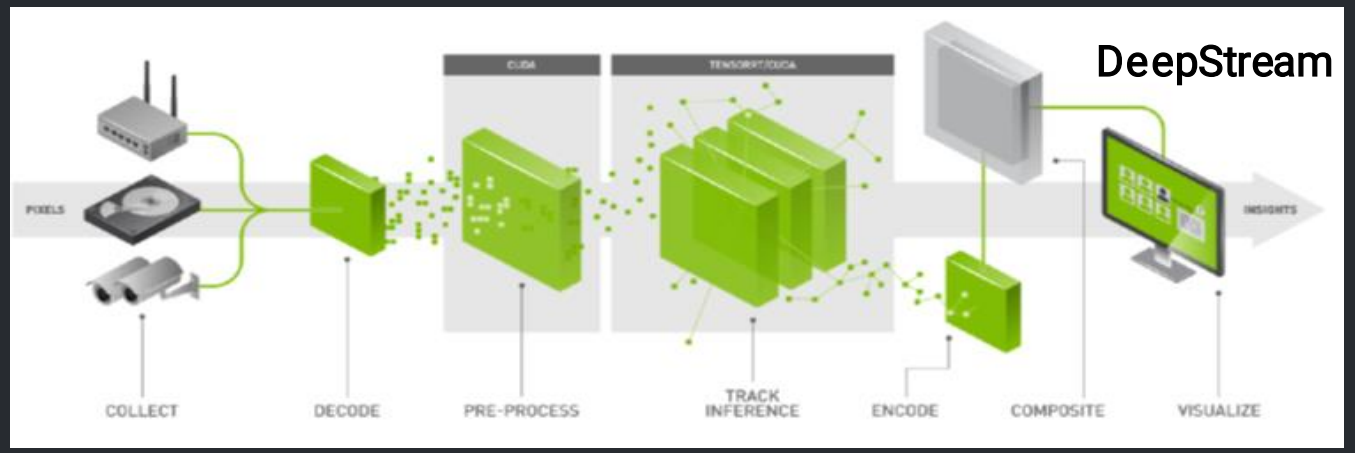
Mapping Deep Stream into Argus Software Architecture





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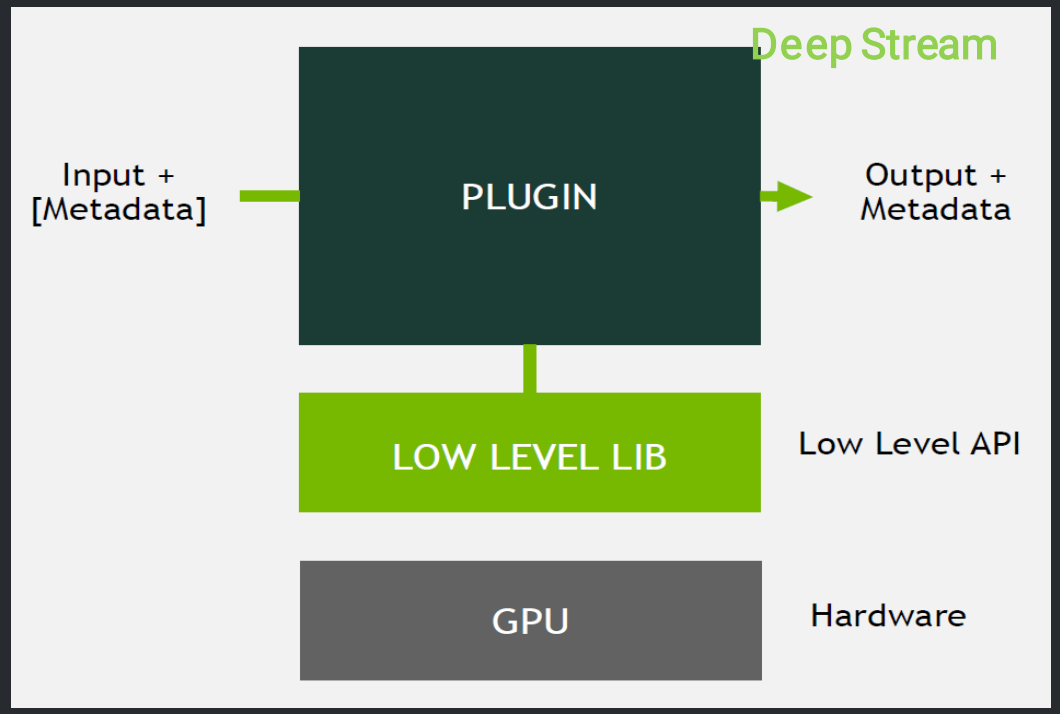
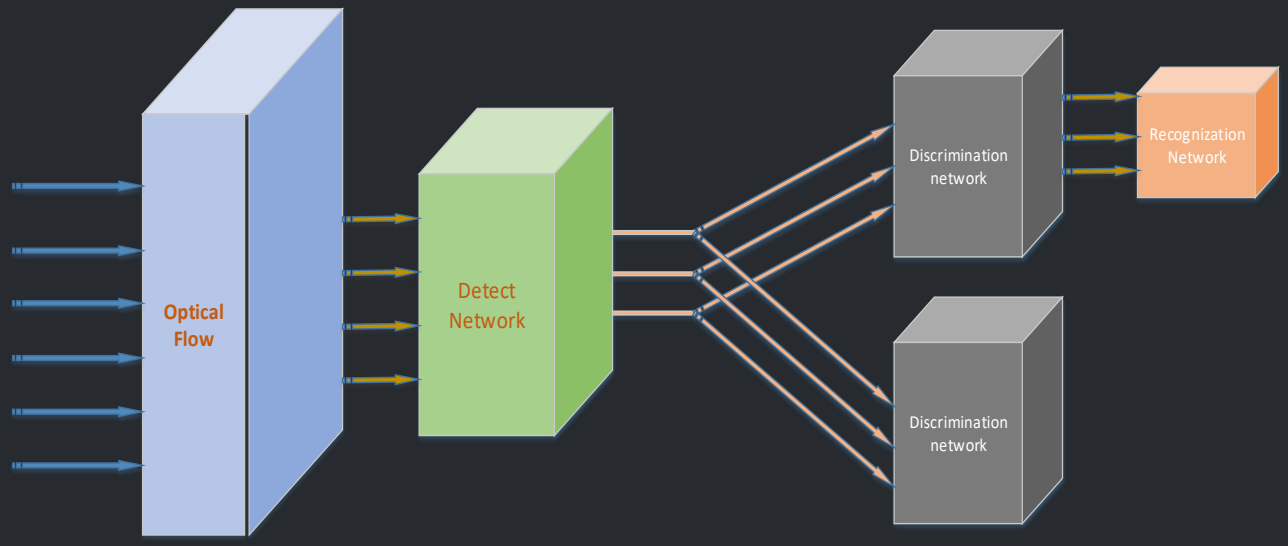
Flexible Streaming Pipeline Design

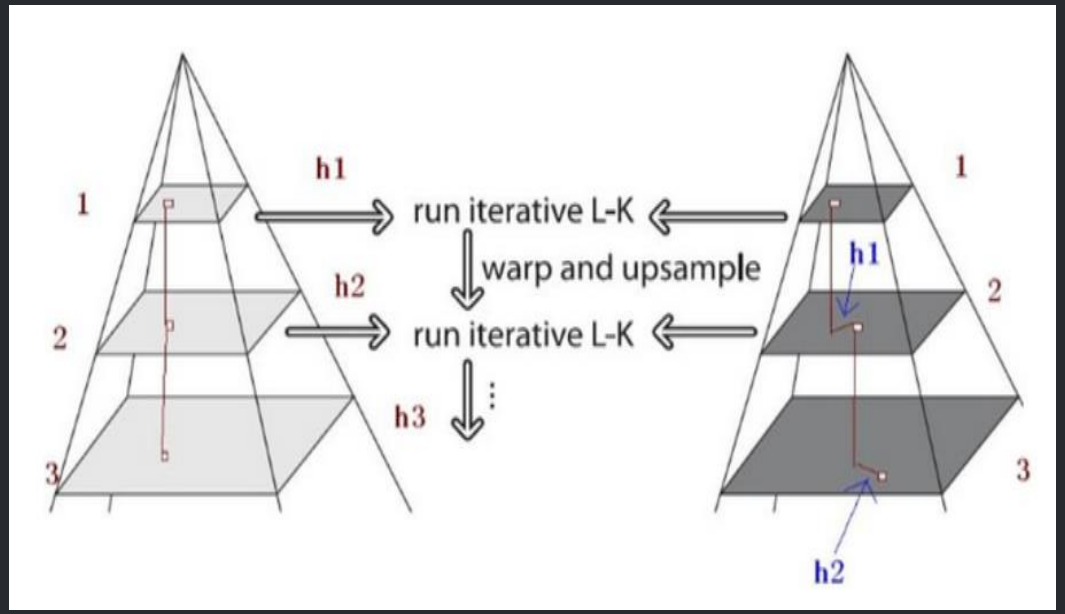


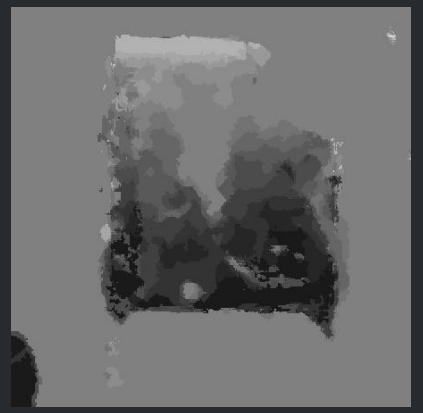


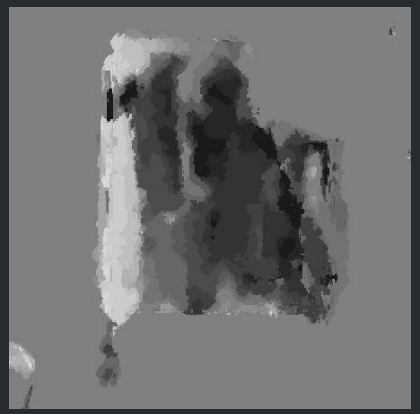
1. A plugin Model based pipeline architecture
2. Graph-based pipeline interface to allow high-level component interconnect
3. Heterogenous processing on GPU and CPU
4. Hides parallelization and synchronization under the hood
5. Inherently multi-threaded

- On-Demand Computing
- Reuse Calculation

Optical Flow Speed-up with CUDA



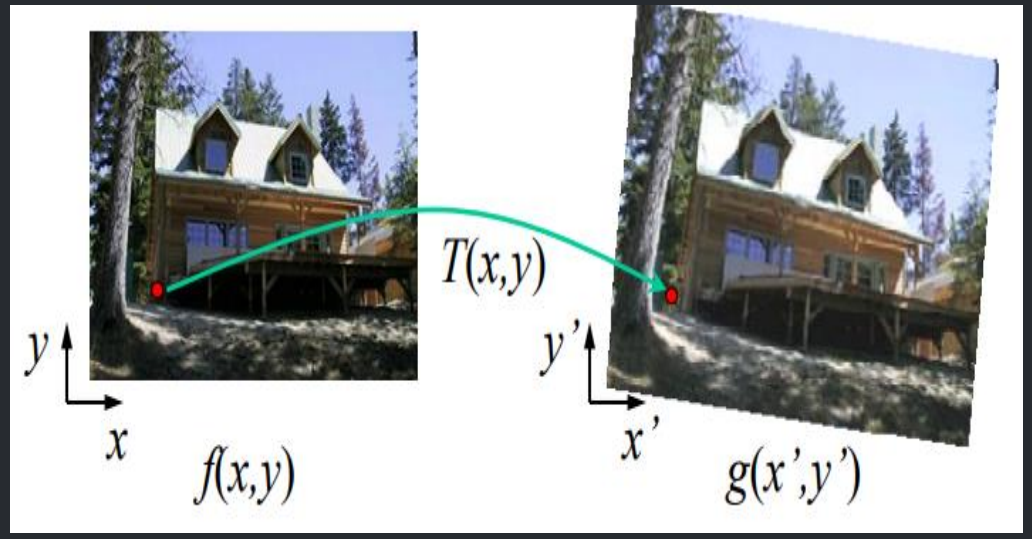




Runtime：8ms

cv::cuda:OpticalFlowDual_TVL1

Optical Flow Speed-up with CUDA

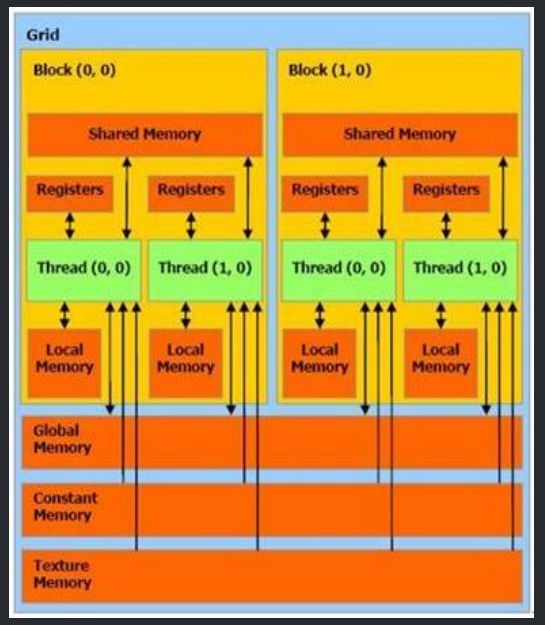


Motion compensation on non-stationary camera

Security camera is fixed

Runtime: 3.6ms Assume camera is fixed in cv::cuda:OpticalFlowDual_TVL1
Runtime: 2.8ms Using CUDA float array instead of cv:GpuMat

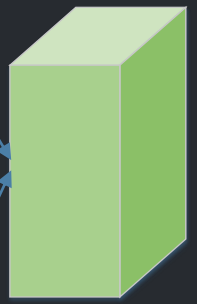
Optical Flow Speed-up with CUDA



224*224 current

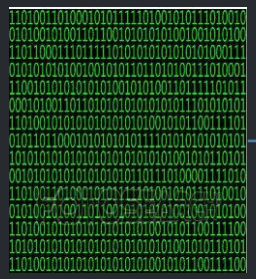
224*224 pre

2.8ms



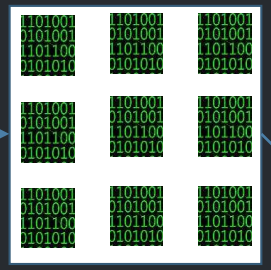
1. Global Memory
2. Block = (224*224)/(32*8)
3. each Step Sync all Block

224*224 current

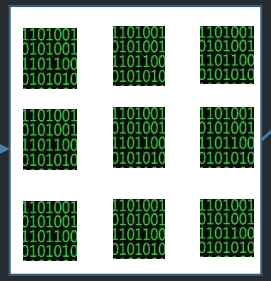


224*224 pre

1.3ms



224*224 current = 32*32* 49

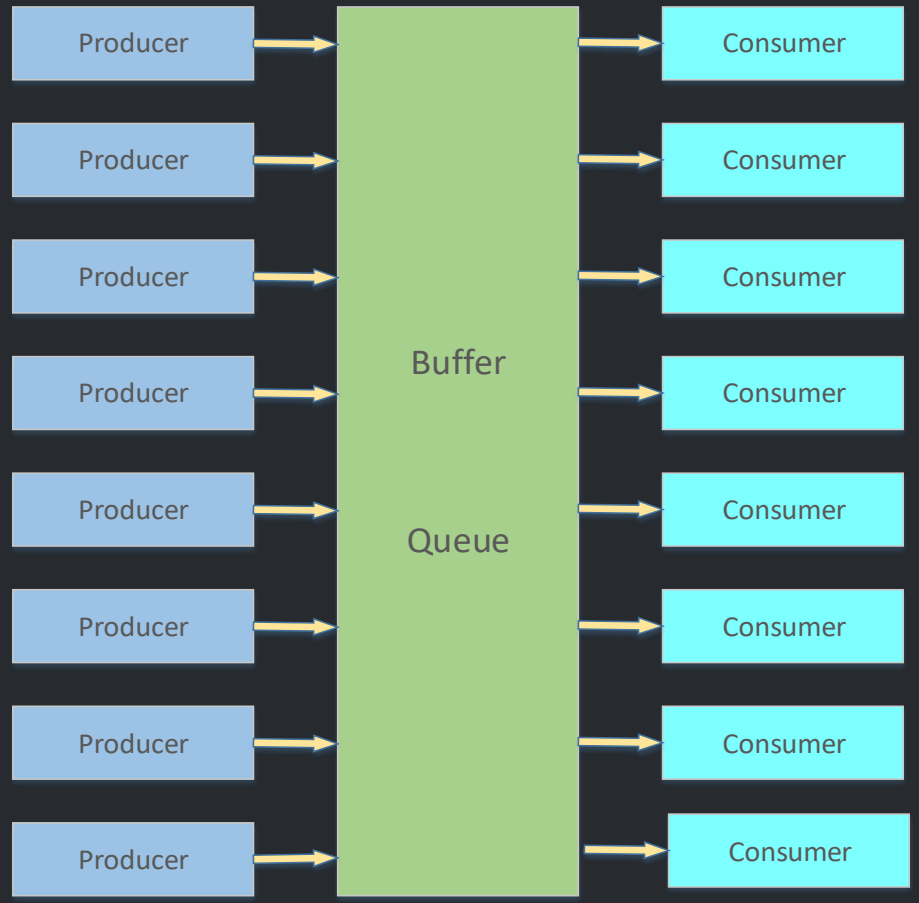


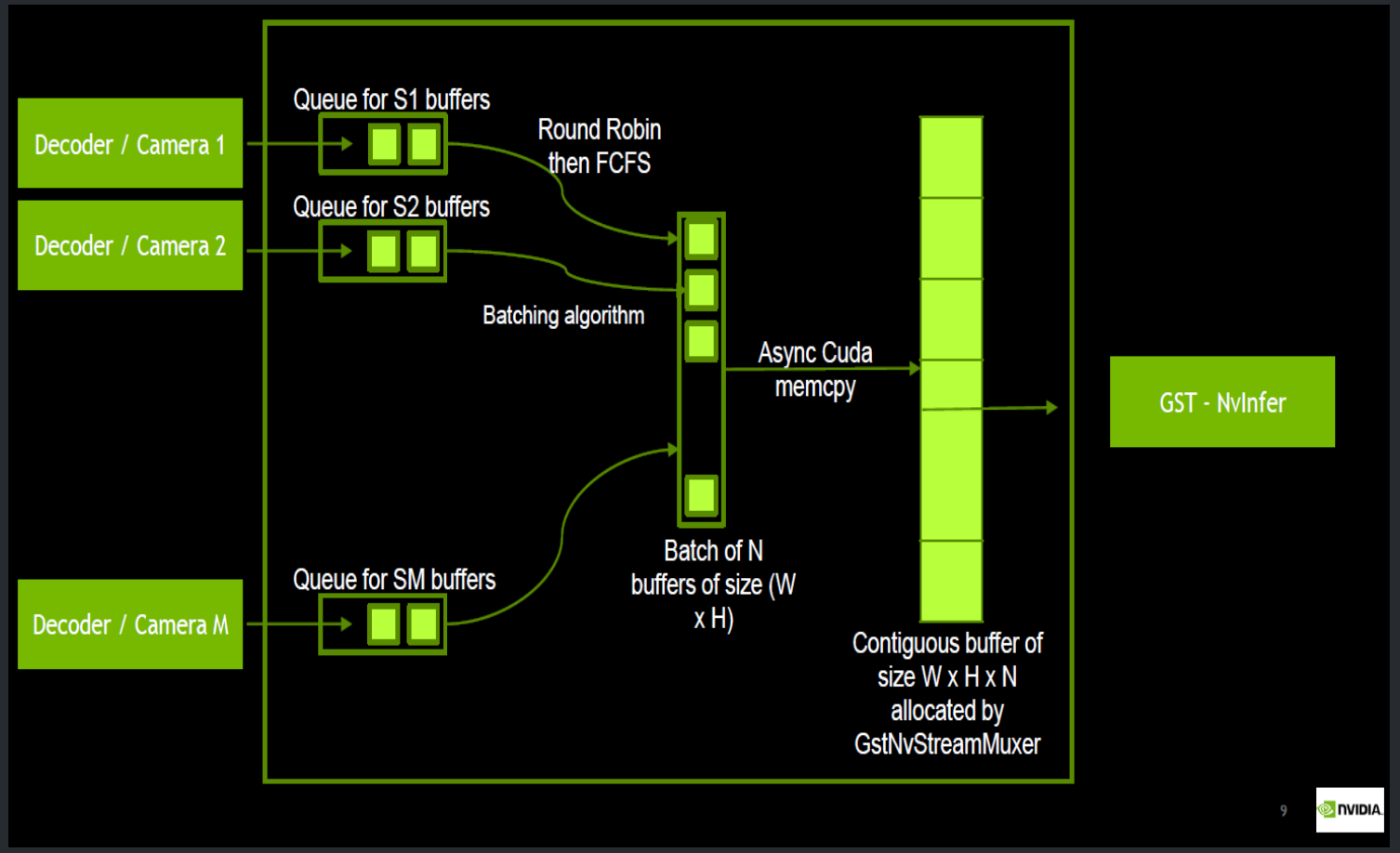
224*224 pre = 32*32* 49

1. Share Memory
2. Block = (224*224)/(32*32)=49
3. Finally Sync all Block

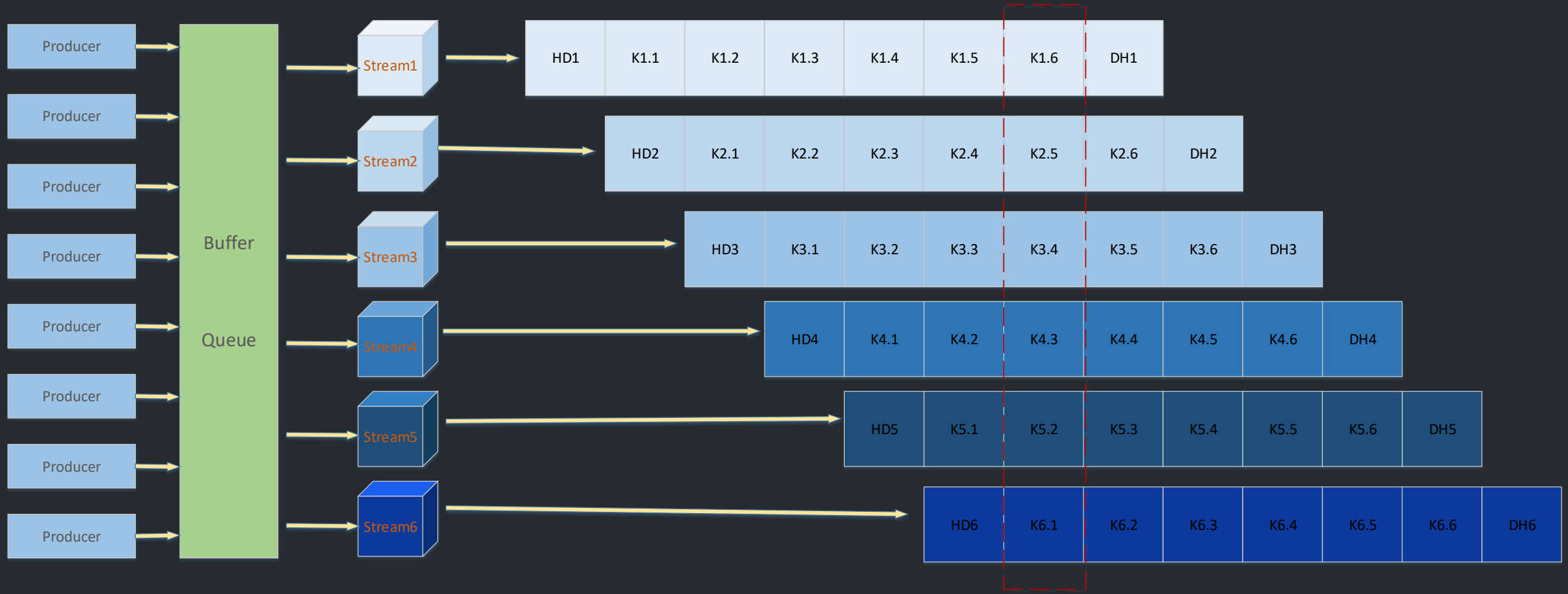
In deployment, the GPU server adopts Tesla P4 GPU.

Concurrent Asynchronous





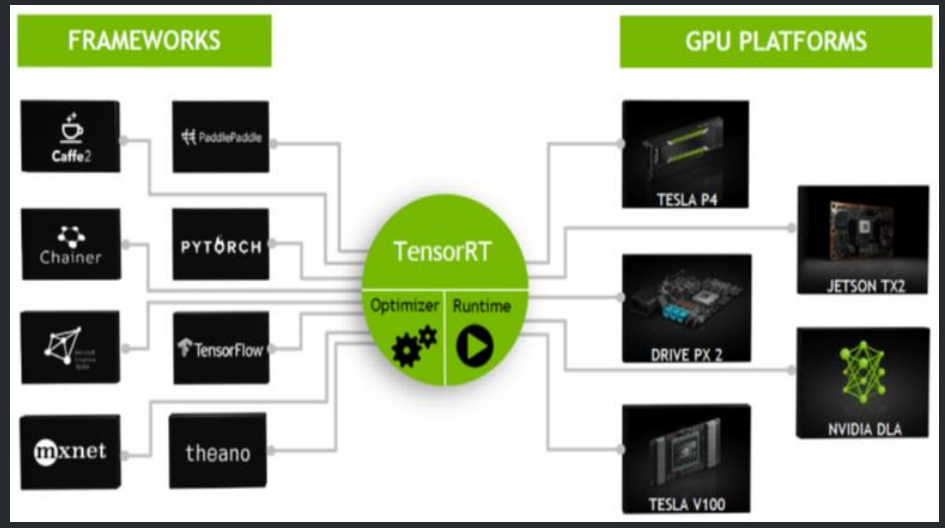
Concurrent Asynchronous With Mutil-Stream



Model Acceleration based on TensorRT

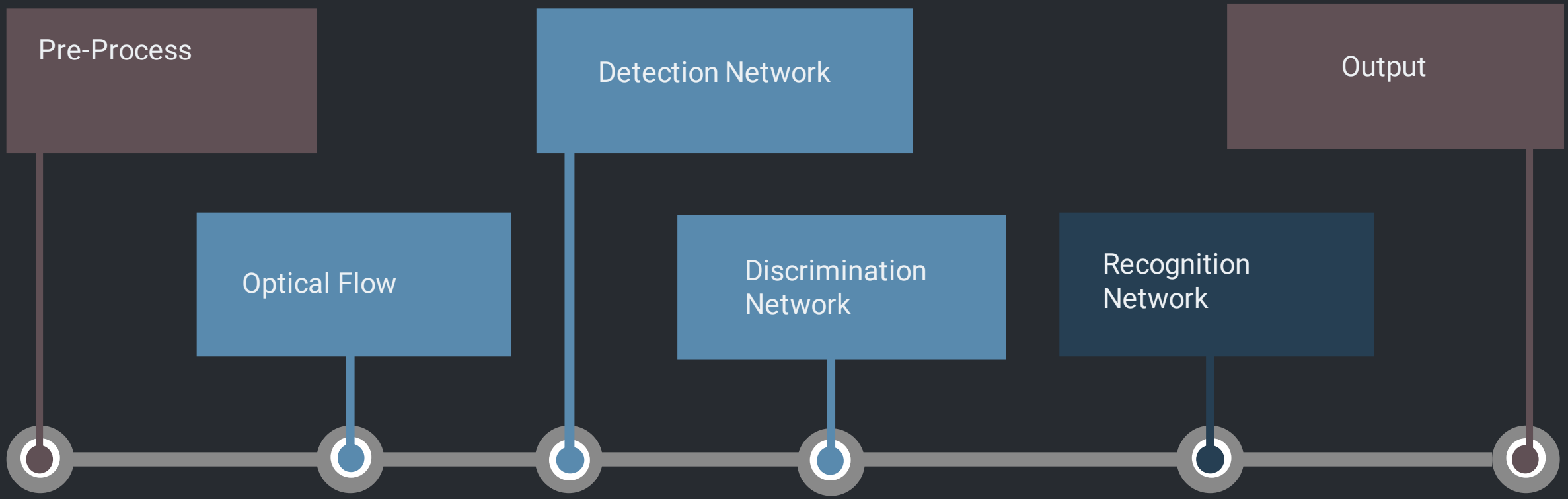
Model	Accuracy	Inference Speed
VGG16	93%	113ms
VGG16-Pruning	89%	32ms
VGG16-lowrank	94%	37ms
VGG16-lowrank-Pruning	93.5%	32ms
VGG16-lowrank-Pruning-TensorRT	93.5%	15.9ms
VGG16-lowrank-Pruning-TensorRT-Int8	93.5%	7.5ms

Model	Accuracy	Inference Speed
PELEE	97.1%	2.48ms
PELEE-TensorRT	98.07%	1.24ms
PELEE-TensorRT-Int8	98%	0.91ms



Measurement on Tesla P4 GPU

Flexible Computing Resources Allocation



Run in CPU | Run in GPU | Run in CPU or GPU

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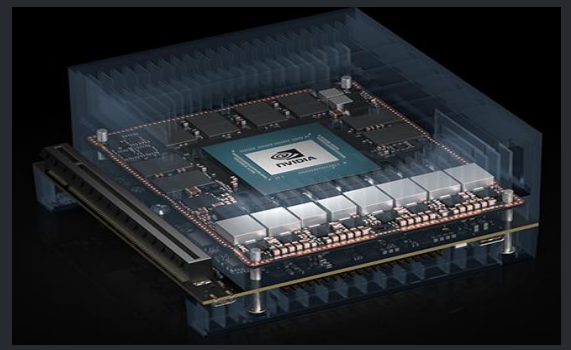
Flexible Product Line Based on Various Computing Platforms



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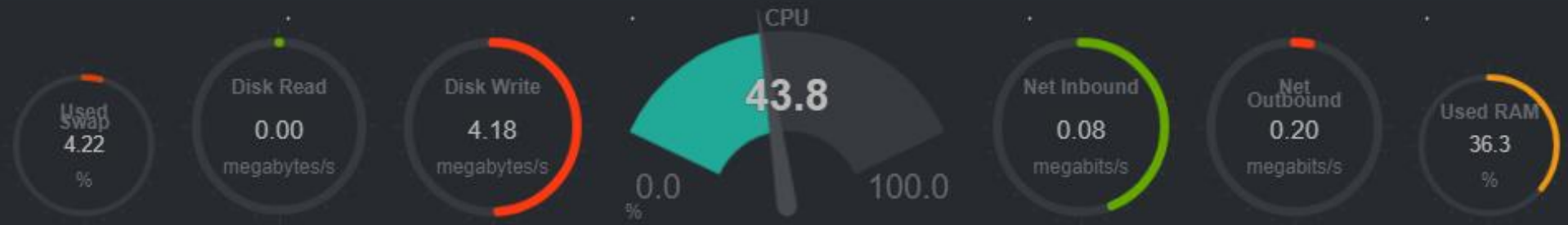
System Metric of LPSS Based on NVIDIA Tesla P4



	CPU Utilization	CPU Memory	GPU Utilization	GPU Memory
average	12%	7G	50%	2.6G
peak	45%		86%	

In deployment, the device adopts two INTEL Xeon E5-2620V4 CPUs and two Tesla P4 GPUs, which can process 32 video streams.

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System Metric of VAPD Based on NVIDIA Tesla P4

	CPU Utilization	CPU Memory	GPU Utilization	GPU Memory
average	10%	8.5G	40%	2.8G
	100%	32G	100%	8G
peak	17%		85%	
	100%		%|	

In deployment, the device adopts the Intel Core i7-6800k CPU and Tesla P4 GPU, which can process 16 video streams.

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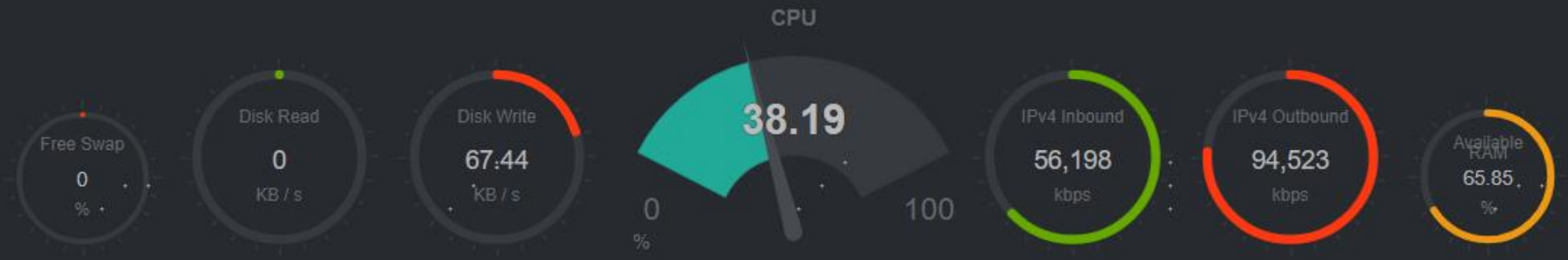
System Metric of VAPD Based on NVIDIA Jetson Xavier



	CPU Utilization	CPU Memory	Single GPU Utilization	SingleGPU Memory
average	43%	3.3G	40%	1.0G
peak	85%		92%	

In deployment, the device adopts Xavier, which can process 20 video streams.

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Future Planning

Future Planning

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- Loading Procedure Structuring System
- Violated Action Pattern Detection
- 6S Pattern Detection
- Unfamiliar Scene and Sample Collection
- Package Lifecycle Tracking System
- Facility Abnormal Invasion Detection
- Staff Efficiency Analysis
- Freight Reflux Detection and Counting
- Employee Image Assurance System

Thank You For Watching

SF Technology · Department of Computer Vision

Neo Song
2019.02

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